Bozhong 19-6 Field, A Fractured Metamorphic Basement Reservoir, Offshore Bohai Bay Basin, China: An Archean Deeply Buried Hill Play

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

In the Bohai Bay Basin supergiant oil field with high exploration intensity in eastern China, it has been a challenge to maintain large-scale gas exploration under the circumstances of declining crude oil production year by year. The deeply buried-hill reservoir was previously paid little attention as it is featured with depths of more than 4000m (13123ft) and few gas reserves were discovered. However, in our recent investigations and exploration practices, the Bozhong 19-6 integrated metamorphic deeply buried hill (more than 4000m) condensate gas field, which is the largest one in the world. Bozhong 19-6 field is a buried hill reservoir which drilled 96m to 997m of metamorphic rocks in gas-bearing intervals. Based on detrital zircon U-Pb dating of 35 samples from sidewall core, we obtained the isotopic age is 2200~2800Ma, suggesting Paleoproterozoic-Archean which constrains the formation age of metamorphic rocks. A combination of seismic, wireline, FMI and core data shows that metamorphic rocks are mainly gneiss, metamorphic granite, mixed gneiss, cataclastic rocks and porphyry. The reservoir space can be divided into three categories according to their genesis: weathering leaching pores (fractures), intrainstalline fractures of mineral particles and structural fractures, the fracture is characterized by multi-stage formation, which provides effective storage space for the gas. The porosity and permeability test results of 228 metamorphic cores show that porosity range from 0.2% to 21.9% (4.4% on average) and permeability range from 0.003 to 614.784×10-3μm^2 (5.050×10-3μm^2 on average), indicating that the metamorphic reservoirs in this area are highly heterogeneous, thus can be divided into two zones in vertical

profile. The upper reservoir zone has a thickness of 40 ~ 300 m, higher natural gamma for 150-300 API, showing zigzag, relatively low resistivity about 20-500Ω•m , net gross ratio of 0.18 ~ 0.68, porosity of 0.6% ~ 17.0%, and a permeability of 0.05~90.30×10-3μm^2, under the dual influence of tectonic activity and weathering leaching. The inner fracture zone is mainly of tectonic origin, has a thickness of 230 m, large number of fractures were observed in both microscopic and FMI, porosity around 3%, differ property from the upper reservoir zone. It shows that reservoir development is mainly controlled by four tectonic activity since the Indosinian period. In the guidance of the fracture zoning models, a breakthrough of gas exploration has been made with over 100 billion cubic meters of gas reserves in Archean deeply buried hill of Bozhong 19-6 field in southwestern Bozhong sag.